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Effects of Crew-Aiding Behaviors on Soldier Performance During Target Engagement Tasks in a Virtual Battlefield Simulation

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Agenda

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- Introduction
- Overview
- Method
- Results
- Discussion
- Conclusion
- Questions



Introduction

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- U.S. Army network-centric, digital battlefields continue to expand
- Greater amounts of incoming information and increased resource demands
 - Maintain local SA
 - Providing information and receiving orders
 - Platform mobility
 - Route planning and control of unmanned assets
 - Sensor monitoring
 - Seek out, close with, and destroy enemy forces

- Increase in Soldier workload
 - Performance degradation (e.g., accuracy, latency)
 - Errors
- Decrease in time available to complete tasks

Overview

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- Research focused on key aspect of “Seek out, close with, and destroy enemy forces”
 - Target prioritization
 - Weapon selection
 - Munition matching (weapon type and target)
 - Target engagement
- Decision aids (Crew Aiding Behaviors) for target prioritization, weapon and munition selection, and target engagement

- Effects on workload and task time (stress and SA ancillary)
- Controlled experiment conducted to determine effects of CABs
 - Degree of effect unknown
 - Not all automation “enhancements” have been shown to reduce Soldier burdens
 - FBCB2 spot reports

- Twelve active duty male Soldiers
 - Senior NCOs and one Officer
 - Primarily Armor MOS
- Task training in both conditions
- Counterbalanced order by conditions
- Mixed-model ANOVA
 - Within Subjects:
 - Baseline, CAB, NoCAB
 - Between Subjects: Treatment order
 - CAB 1st vs. NoCAB 1st

Method

- Objective performance measures
 - Stress via Galvanic Skin Response (GSR)
 - Task time
- Subjective performance measures
 - Stress survey (physical and mental)
 - NASA-TLX
 - China Lake SA

Method

- GSR armband



■ NoCAB

Presented randomized list of targets

- Prioritize based on proximity and threat
- Select appropriate weapon system
- Select appropriate munition
- Engage and destroy target
- Move to next target
- Repeat until all targets destroyed or munitions expended

Method

■ CAB

Presented list of targets sorted and prioritized automatically

- Verify and select each target in queue
- Verify recommended weapon
- Verify recommended munition
- Engage and destroy target
- Move to next target
- Repeat until all targets destroyed or munitions expended

■ Baseline

- GSR taken during duty hours not related to experiment
- Survey ratings of typical drive from residence to base



Method

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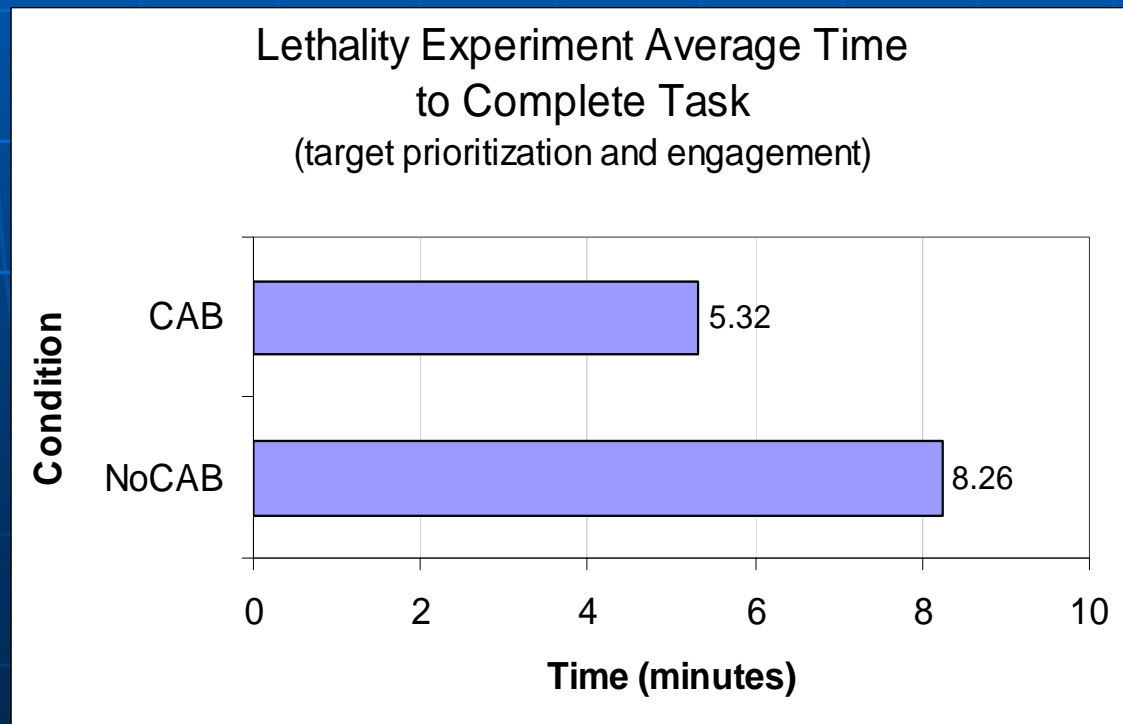
Soldier-in-the-loop (SIL) simulator

Figure 1 displays three screenshots of the game interface, illustrating the 'Reports', 'Target Acquisition', and 'Planning Map' panels.

The 'Reports' panel (left) shows a list of assets (vAVY1, vAVY2, vAVY3, vAVY4) with their status (e.g., 'Active', 'Inactive') and location (e.g., 'North', 'South'). The 'Target Acquisition' panel (middle) shows a 3D view of the battlefield with a target (vAVY1) highlighted. The 'Planning Map' panel (right) shows a top-down map view with various tactical elements and a list of assets on the right side.

Results

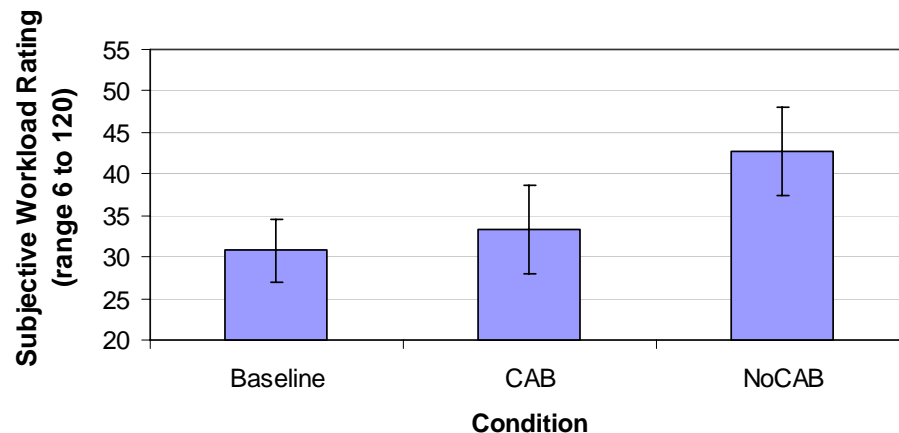
- Significant reduction in task time
 - 36% (2 min 56 sec.) faster using CABs



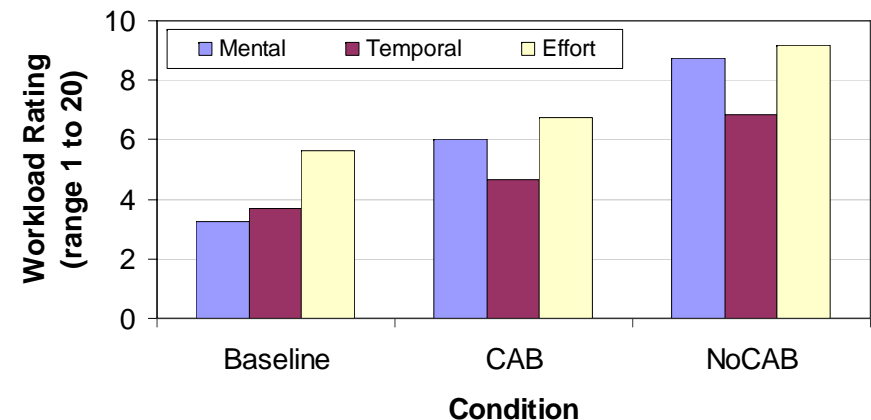
Results

- Significant reduction in workload
 - Overall workload reduced by 28%
 - Mental and Temporal 46%, Effort 36%

Lethality Experiment Average Overall Workload



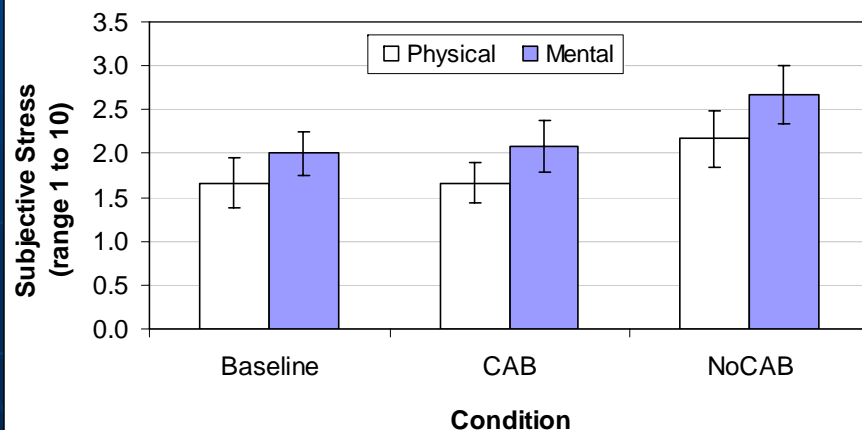
Lethality Experiment Average Workload (subscales)



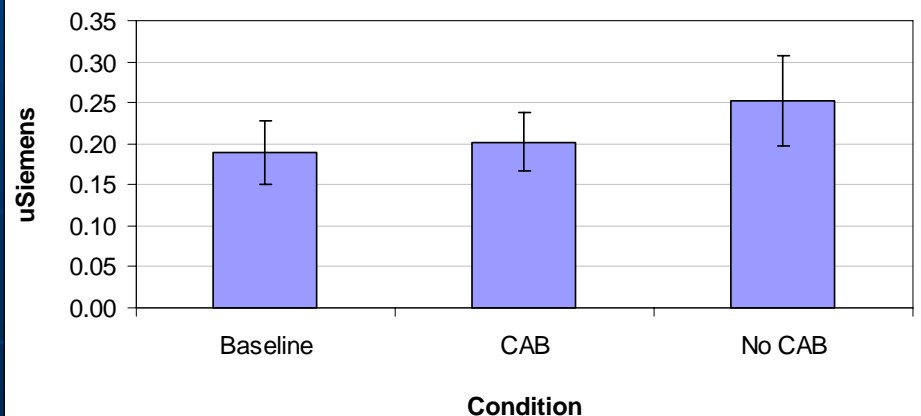
Results

- Reduction in stress
 - Not statistically significant at $\alpha=.05$
 - Survey $p=.051$; GSR $p=.059$
 - Trend of lower stress in CAB condition for both survey and GSR stress

Lethality Experiment Average Stress Levels
(subjective rating)



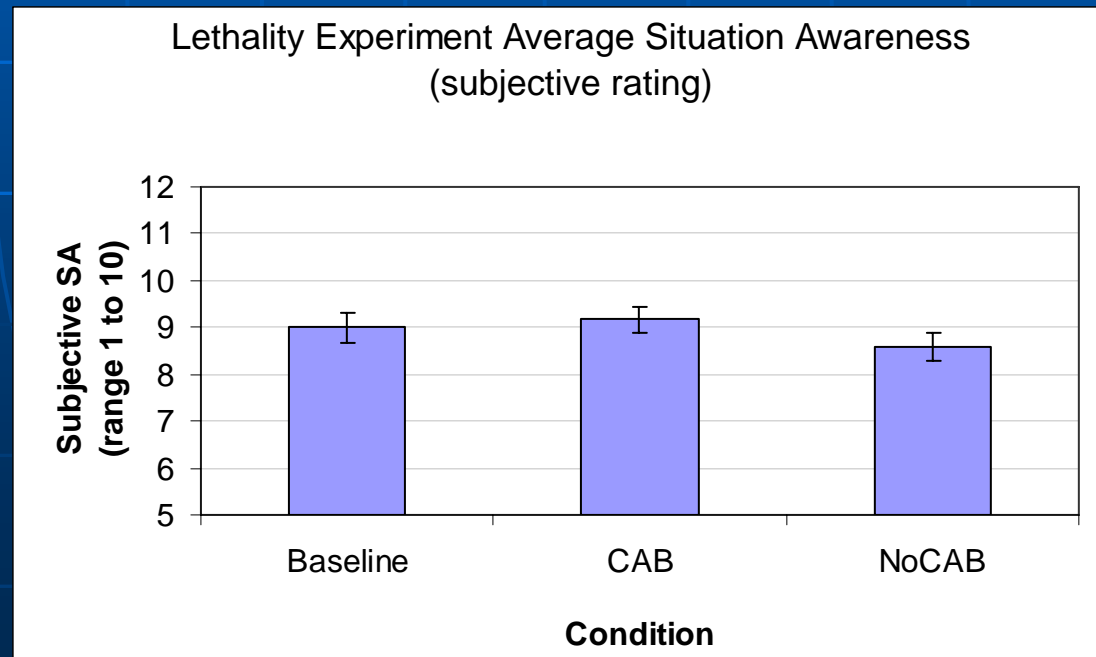
Lethality Experiment Average Stress Levels
(objective GSR)



Results

■ Increase in SA

- Not statistically significant at $\alpha=.05$ ($p=.063$)
- Trend of increased SA in CAB condition



■ Summary

- Significant reduction in task time
 - 36% faster using CABs
- Significant reduction in Soldier workload
 - Overall workload reduced by 28%
 - Mental and Temporal 46%, Effort 36%
- Reduction in Soldier stress and Increase in SA
 - Though not statistically significant, trends favored CABs
 - Trend of lower stress (survey and GSR) when using CABs
 - Trend of increased SA when using CABs

■ Implications

- Decision aids can make positive contributions to Soldier performance
- Soldiers may be able to better attend to increasing 'digital battlefield' demands
- CABs offer robust configuration and maintain a human-in-the-loop for critical tasks (e.g., decision to fire)
- Potential for incorporation into Future Combat Systems (FCS)



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Questions

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